REMARKS/ARGUMENTS

Claim 2 has been cancelled and the subject matter of claim 2 has been introduced into claim 1. Claim 1 now corresponds to originally presented claim 2. Claim 17 has been amended to overcome the Examiner's rejection. Claim 10 has been amended to remove multiple dependencies. No new subject matter has been entered.

The Examiner has rejected claims 1-17, 22, and 24 under 35 U.S.C 102(e) as being anticipated by Vachtsevanos et al. (US 6,269,179).

Vachtsevanos et al. discloses an apparatus for inspecting surface mount components. The inspection system includes both vision and infrared inspection techniques to determine the presence of surface mount components on a printed wiring boards, and the quality of solder joints of surface mount components on printed wiring boards by using data level sensor fusion to combine data from two infrared sensors to obtain emissivity independent thermal signatures of solder joints.

Claim 1 now recites a method for inspecting an object and detecting defects, the method comprising: injecting a heat pulse by light beam at a selected point on a bottom surface of the object, whereby heat transmits through a top surface of the object; capturing a sequence of consecutive thermal images of the top surface of the object to record heat diffusion over time resulting from the heat pulse; comparing the heat diffusion over time at the point on the object to a reference; and determining whether the object comprises any defects.

Figure 3 of Vachtsevanos et al. illustrates the apparatus being described in the specification. A mounting 18 supports the object under inspection. A laser source 12 injects a heat pulse on the object and a thermal infrared camera 16 captures thermal images. However, the heating and imaging of the object under inspection is performed in a reflective manner. That is, the laser heats the top surface of the object and the camera images the top surface of the object.

The Applicants claim heating the bottom surface of the object and imaging the top surface of the object to record heat transmitted therethrough and diffused through the top surface of the object. This mode of operation, called transmissive mode of operation, differs from a reflective mode of operation, in that the thermal stimulation is applied to a surface on the opposite side of the specific component under inspection, such as a solder junction, to that of the surface from which the IR measurements are made, thus representing a more direct measure of the heat diffusing through the junction, whereas in the reflective mode of operation, the thermal stimulation is applied to the same surface from which the IR measurements are made, and the cooling of this surface due in part to heat diffusion through the solder junction under inspection is measured, representing a more indirect measure of the heat diffusing through the junction. The direct measurement of the transmissive mode provides a more robust measurement approach.

More specifically, in the transmissive mode, the heat that is injected at the bottom surface of the PCB diffuses throughout the PCB material, including its copper layers and traces, to the base of the solder junction. The temperature differential created between the solder junction interface and the top surface of the component causes the heat to diffuse through the encapsulation of the component to the top surface. The corresponding heat radiated from the top surface is detected by the IR camera, thus presenting a direct measurement of the heat diffused through the solder junction, which will be disturbed by the presence of an anomaly.

Vachtsevanos et al. does not teach a transmissive mode of operation and therefore, claim 1, as amended, is not anticipated by the reference.

Independent claim 17 has also been amended to overcome the Examiner's rejection under 35 U.S.C. 102(e) as being anticipated by Vachtsevanos et al. Claim 17 now recites an apparatus for inspecting an object and detecting defects, the apparatus comprising: a mounting for supporting the object and exposing a top surface and a bottom surface of the object; a pulsed

laser source having a beam able to be positioned for providing a heat pulse at a precise location on the bottom surface of the object; a thermal camera for capturing thermal images of the top surface of the object; a frame grabber for capturing a sequence of image signals from the thermal camera; a memory unit for storing data representative of heat diffusion over time resulting from the heat pulse obtained from the sequence of image signals; and an analyzing unit for comparing the heat diffusion data to a reference data set, the reference comprising upper and lower limits of acceptable thermal heat diffusions of a specific area on the object.

The amendment to claim 17 consists in specifying that the heating and imaging is done in a transmissive mode by specifying that the mounting exposes a bottom surface of the object for heating and a top surface of the object for imaging. The laser source is positioned beneath the bottom surface of the object and the thermal camera is positioned above the top surface of the object. Support for this amendment can be found in figure 1, which illustrates the configuration recited by the claim. The mounting plate 2 exposes the top and bottom surfaces of the printed circuit board 1 and an infrared camera 16 is positioned about the board. Figure 4 demonstrates a light beam 30 positioned under a ball from the ball grid array to heat small area 31.

Vachtsevanos et al. does not teach the apparatus as now claimed by claim 17. The reference clearly discloses performing reflective heating and imaging, as is suggested by the apparatus illustrated in figures 1 and 3 of Vachtsevanos et al.

Furthermore, Vachtsevanos et al. does not suggest transmissive heating and imaging. The apparatus provided cannot be easily modified to perform transmissive heating and imaging. The assembly line inspection system for surface mount devices, as shown in figure 1 of Vachtsevanos et al., would require substantial modification in order to be capable of performing transmissive heating and imaging and there is no such suggestion in the disclosure provided therewith.

Therefore, the Applicants believe claims 1 and 17 are not anticipated or suggested by Vachtsevanos et al. and therefore, claims 1 and 3 to 24 are believed to be patentable over the references cited.

CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 650-326-2400.

Respectfully submitted,

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